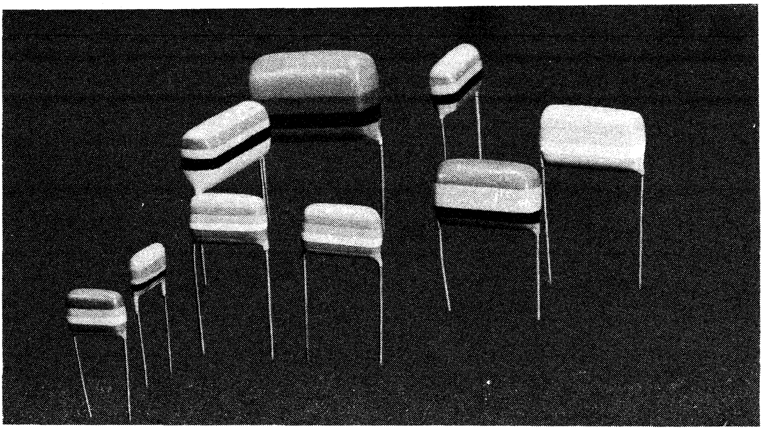
METALLISED POLYESTER CAPACITORS

"flat film" type



RZ 22359-4

Nominal voltage	100	250	400	630	V
Capacitance range	0.1- 6.8	0.01-2.2	0.01-1	0.01-0.47	μF

APPLICATION

These capacitors are designed primarily for use as coupling and decoupling capacitors for electronic circuits employing printed wiring.
Due to the almost negligible temperature dependency they offer in many cases essential advantages over ceramic disc capacitors.

Maximum overvoltage

Special attention is drawn to the fact that the allowed 40% overvoltage for the 250 V versions permits these capacitors to be employed in anode and screen grid circuits, instead of previously used 400 V capacitors.

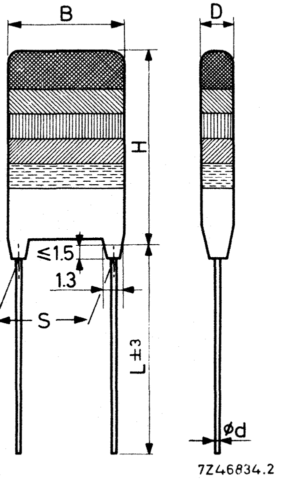
CONSTRUCTION

The dielectric material is metallised polyethylene-terephthalate.
Capacitors with a dielectric material of metallised polycarbonate can be supplied on request.

Dimensions in mm and colour code

colour	1st figure of cap. value	2nd figure of cap. value	multiplying factor	capacitance tolerance	nominal voltage
black	-	0	1	±20%	
brown	1	1	10		100 V
red	2	2	10^2		250 V
orange	3	3	10^3		
yellow	4	4	10^4		400 V
green	5	5	10^5		
blue	6	6			630 V
violet	7	7			
grey	8	8			
white	9	9		±10%	

body colour



For B, D and H see Table II.

Table I

if B =	d =	S =	L =
12.5	0.6	10.2 ± 0.5	22 + 4
17.5	0.8	15.3 ± 0.3	32 + 4
22.5	0.8	20.3 ± 0.3	30 + 4
30	0.8	27.9 ± 0.3	28 + 4

TYPES

Composition of the catalog number

2222 342 .....

capacitance code, see Table II

code for dielectric material [1]), nominal voltage and capacitance tolerance

24 = PETP, 100 V, 20%
25 = PETP, 100 V, 10%
44 = PETP, 250 V, 20%
45 = PETP, 250 V, 10%
54 = PETP, 400 V, 20 %
55 = PETP, 400 V, 10 %
64 = PETP, 630 V, 20 %
65 = PETP, 630 V, 10 %

Example: The catalog number of a 0.033 μF/400 V capacitor with dielectric of PETP, tolerance ± 10 %, is 2222 342 55333.

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[1]) Metallised polycarbonate available on request.

Table II

cap. (μF)	cap. code	max. dimensions (mm)											
		100 V versions			250 V versions			400 V versions			630 V versions		
		D	B	H	D	B	H	D	B	H	D	B	H
0.010	103				4	12.5	9	4	12.5	9	4	12.5	9
0.015	153				4	12.5	9	4	12.5	9	5	12.5	10
0.022	223				4	12.5	9	4	12.5	9	6	12.5	11
0.033	333				4	12.5	9	5	12.5	10	6	17.5	11
0.047	473				4	12.5	9	6	12.5	11	7	17.5	12
0.068	683				5	12.5	10	6	17.5	11	6.5	22.5	11.5
0.10	104	4	12.5	9	6	12.5	11	7	17.5	12	7.5	22.5	12.5
0.15	154	4.5	12.5	9.5	6	17.5	11	6.5	22.5	11.5	9.5	22.5	14.5
0.22	224	5.5	12.5	10.5	7	17.5	12	7.5	22.5	12.5	9.5	30	14.5
0.33	334	5.5	17.5	10.5	6.5	22.5	11.5	9.5	22.5	14.5	10	30	18
0.47	474	6.5	17.5	11.5	7.5	22.5	12.5	9.5	30	14.5	12	30	20
0.68	684	6	22.5	11	9.5	22.5	14.5	10	30	18			
1.0	105	7	22.5	12	9.5	30	14.5	12	30	20			
1.5	155	8.5	22.5	13.5	10	30	18						
2.2	225	8.5	30	13.5	12.5	30	20.5						
3.3	335	9	30	17									
4.7	475	11.5	30	19.5									
6.8	685	14	30	22									

Intermediate values according to the E12 range are available on request. The dimensions are identical to those of the next higher value in the standard E6 range. The capacitance tolerance is either ±10% or ±20%. The preferred tolerance is ±20% for ≤ 0.22 μF, and ± 10% for > 0.22 μF.

TECHNICAL PERFORMANCE

Unless otherwise specified all electrical characteristics apply to an ambient temperature of 20 ± 5 °C, an atmospheric pressure of 930-1060 mbar and a relative humidity of 45-75 %.

Working temperature range	-40/+100 °C
Maximum d.c. working voltage	
up to 85 °C	nominal voltage (V_{nom})
derating	1.25% per deg C above 85 °C
Maximum overvoltage for 1 minute per hour.	100 V and 250 V versions: 40% 400 V and 630 V versions: 25%
Maximum a.c. voltage, 50-60 Hz (never to be exceeded at other frequencies)	100 V versions: 63 V 250 V versions: 160 V 400 V versions: 200 V 630 V versions: 220 V
Calculation of the dissipation	with the aid of Fig.1
Maximum dissipation	Fig.2
Pulse loads, maximum steepness	see Table III

Test voltage (d.c.) for 1 minute	1.6 x nominal voltage
Capacitance drift during life	
d.c. loaded, at 1.5 V_{nom} and 85 °C	< 5%
at 25 °C	< 2%
a.c. loaded, for B = 12.5 mm	< 25%
B = 17.5 mm	< 20%
B = 22.5 mm	< 15%
B = 30 mm	< 10%
Capacitance as a function of temperature and frequency	Fig.3 and Fig.4
Insulation resistance at 20 °C	
for C ≤ 0.33 μF	R > 30 000 MΩ
for C > 0.33 μF	RC > 10 000 s (MΩ.μF)
Insulation resistance as a function of temperature	Fig.5. Decrease of minimum values is a factor 2 per 10 deg C above 20 °C
Losses (tan δ) at 1 kHz and 20 °C	PETP versions: < 75 x 10^{-4} polycarbonate versions: < 30 x 10^{-4}
at 10 kHz and 20 °C	PETP versions: < 250x10^{-4} polycarbonate versions: < 100x10^{-4}
Losses as a function of temperature and frequency	Fig.6 and Fig.7
Resonance frequency	Fig.8
Climatic robustness	for 100V version : 40/100/04 (IEC 68) 4 days at 40 °C and 90-95 % R.H. for 250/400/630V versions : 40/100/21 (IEC 68) 21 days at 40 °C and 90-95 % R.H.
Solderability conforming to	I.E.C. 68-2, test T3.2 on 6 mm from the capacitor body
Soldering conditions for p.w. boards	5 seconds, 250 °C
Thermal shock proof	2 seconds, 350 °C
Lead strength, radial	> 5 N (> 500 g)
axial	> 2.5 N (> 250 g)

Table III

nominal voltage	maximum steepness (V/μs)			
	dimension B			
	12.5 mm	17.5 mm	22.5 mm	30 mm
100 V	10	7	4	3
250 V	20	10	7	5
400 V	30	20	10	8
630 V	45	30	15	10

Important note: A metallised film capacitor must not be used in a low-impedance circuit in which any short-circuit current through the capacitor might exceed 400 mA.

CALCULATION OF THE MAXIMUM A.C. VOLTAGE

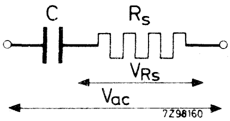
A maximum permissible a.c. voltage has been specified for 50-60 Hz and at 20 °C. This voltage value must also never be exceeded at other frequencies. The permissible a.c. voltage may further be limited by the following requirements:

1) The power dissipation must not exceed the specified limit P_{max}.
2) The steepness of the a.c. voltage must not exceed the specified limit.

Ad 1.

The power dissipated by a capacitor is a function of the voltage over the series resistance (R_s) or of the current through the series resistance and is expressed by

$$P = \frac{{V_{R_s}}^2}{R_s} = I^2 R_s \qquad (1)$$



$$ {V_{R_s}}^2 = \frac{{R_s}^2}{{R_s}^2 + 1/\omega^2 C^2} \, {V_{ac}}^2 \qquad (2a)$$

As for these capacitors $\tan\delta = R_s\omega C$ = always <0.1, the formula (2a) can be simplified to

$$ {V_{R_s}}^2 = \frac{{R_s}^2}{1/\omega^2 C^2} \, {V_{ac}}^2 = {R_s}^2 \omega^2 C^2 \, {V_{ac}}^2 \qquad (2b)$$

Thus

$$P = R_s \omega^2 C^2 \, {V_{ac}}^2 \qquad (3a)$$

or

$$P = (R_s C) \, C \omega^2 \, {V_{ac}}^2 \qquad (3b)$$

The term R_sC can be found from Fig. 1. C (in farads), $\omega = 2\pi f$ and V_{ac} are assumed to be known.

The maximum permissible value of power dissipation (P_{max}), which depends on the dimensions of the capacitor and on the ambient temperature, can be found from Fig. 2. Thus, when the actual power has been calculated with formula (3b), Fig. 2 gives the minimum size of capacitor which can dissipate this power.

May be two or three capacitors having this size can be chosen, namely with different nominal working voltages.

Example of using Fig.1. and Fig.2

A capacitor with dielectric of polycarbonate and a value of 0.33 μF should be used at an a.c. voltage V_{ac} = 180 V, a frequency of 1 kHz and an ambient temperature of 50 °C.
The R_sC-product is 5.10^{-7} ΩF (from Fig.1), so that the power to be dissipated

$$P = (R_sC)\,C\omega^2\,V_{ac}{}^2$$
$$= 5\times10^{-7}\times0.33\times10^{-6}\times4\pi^2\times1000^2\times180^2 = 0.214\text{ W}.$$

Fig.2 shows that at 50 °C capacitors with curve numbers 15 to 23 can be used, thus a minimum size of 9.5 x 22.5 x 14.5 mm. It can be seen from Table II that a choice can be made between 0.33 μF - 400 V and 0.33 μF - 630 V capacitors.

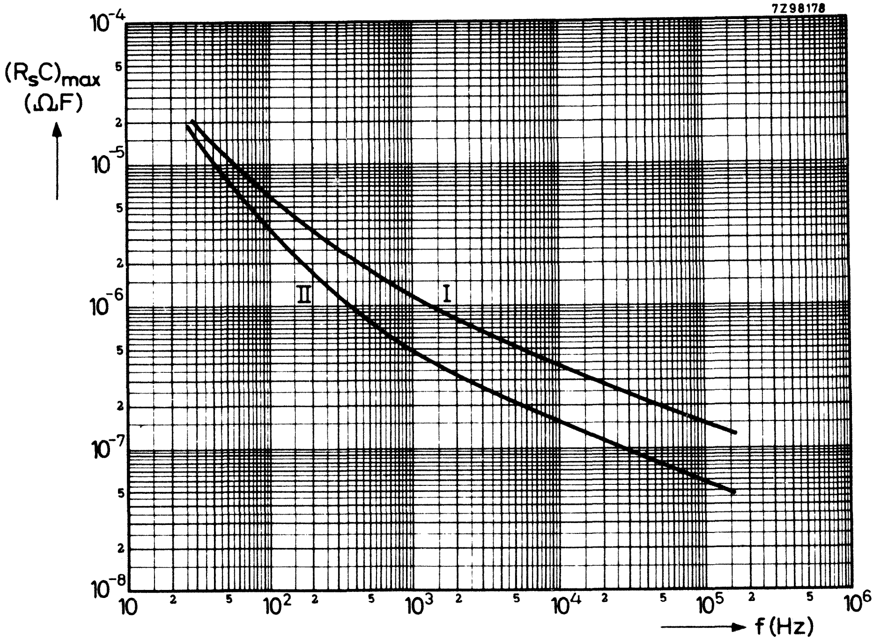
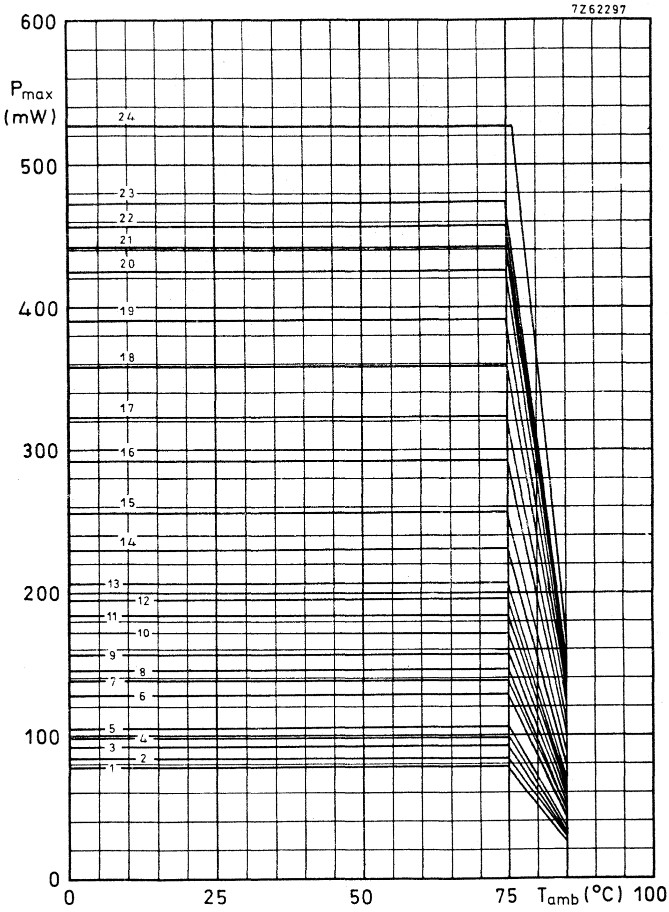


Fig.1. Maximum product of series resistance and capacitance as a function of the frequency

I = PETP versions II = polycarbonate versions



curve	dimensions (mm)		
	D	B	H
1	4	12.5	9
2	4.5	12.5	9.5
3	5	12.5	10
4	5.5	12.5	10.5
5	6	12.5	11
6	6.5	17.5	10.5
7	6	17.5	11
8	6.5	17.5	11.5
9	7	17.5	12
10	6	22.5	11
11	6.5	22.5	11.5
12	7	22.5	12
13	7.5	22.5	12.5
14	8.5	22.5	13.5
15	9.5	22.5	14.5
16	8.5	30	13.5
17	9.5	30	14.5
18	9	30	17
19	10	30	18
20	11	30	19
21	11.5	30	19.5
22	12	30	20
23	12.5	30	20.5
24	14	30	22

Fig.2. Maximum permissible power dissipation as a function of the temperature.

I = PETP versions

II = polycarbonate versions

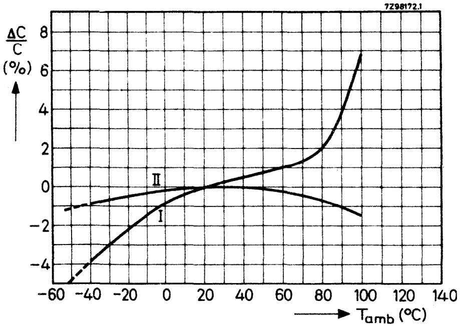


Fig. 3. Capacitance as a function of the temperature

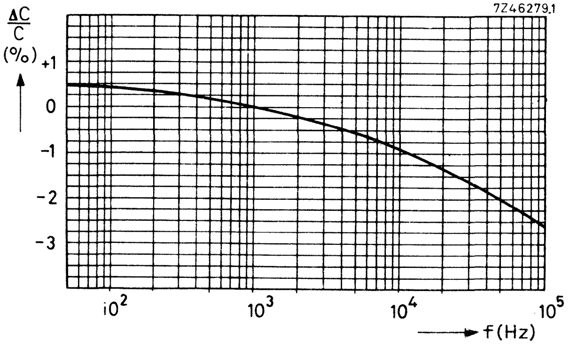


Fig.4. Capacitance as a function of the frequency

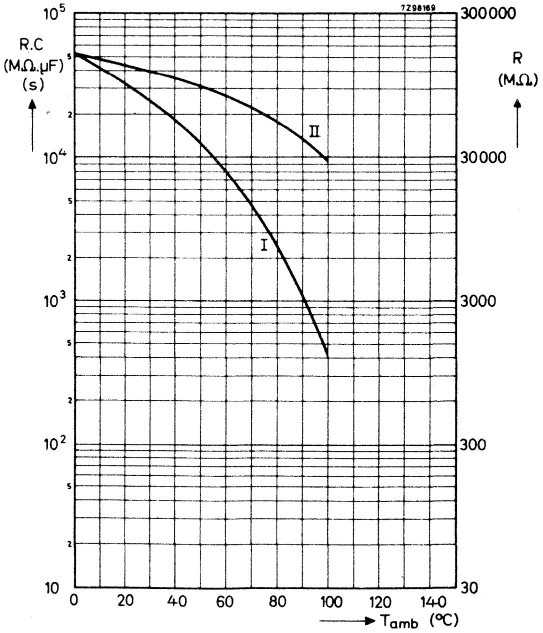


Fig.5. Insulation resistance as a function of the temperature
I = PETP versions II = Polycarbonate versions

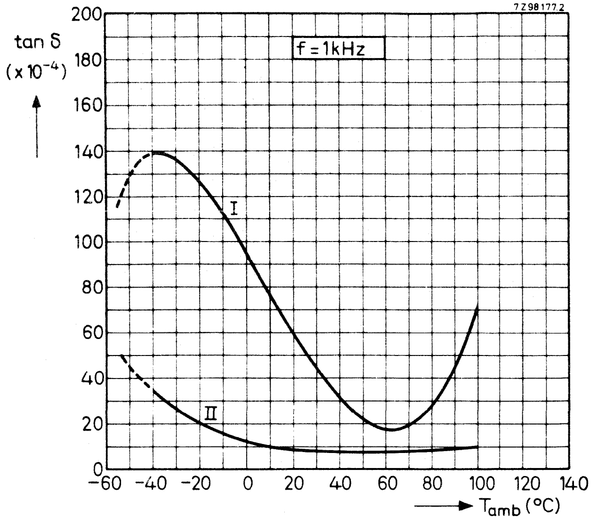


Fig.6. Losses at 1 kHz as a function of the temperature
I = PETP versions II = polycarbonate versions

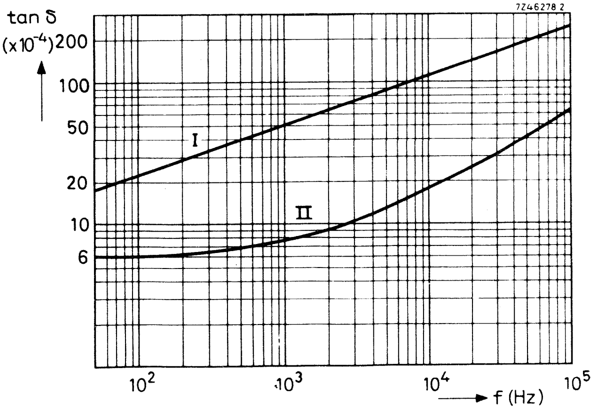


Fig.7. Losses as a function of the frequency
I = PETP versions II = polycarbonate versions

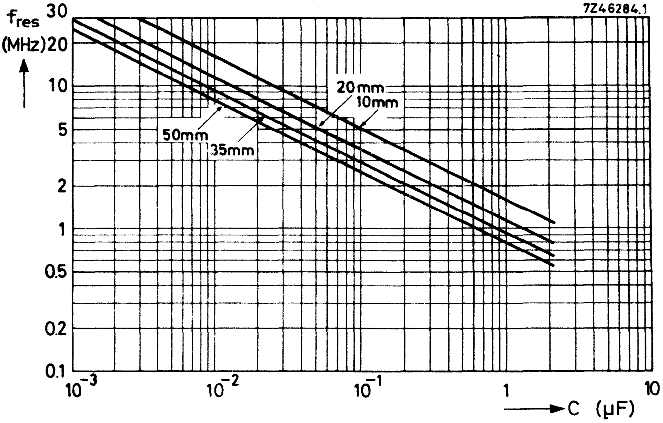


Fig. 8. Resonance frequency as a function of the capacitance, at different total wire lengths